

Maintaining Control of Impurities

Grain cleaning is a vital and first line of defense in maintaining quality and profitability.

Flour milling is a continual process of separating the wheat bran from endosperm and gradually reducing the wheat kernel into flour. The quality

of the flour produced is dependent on several settings and adjustments made by the miller to optimize the gradual reduction process. The desired flour quality also is dependent on the type of product that will be made from the flour.

Cakes, breads, and pastas require different flour characteristics to produce a quality finished product for the consumer.

While the milling process itself to produce a diversity of products can vary, one common denominator for all mills (or millers) remains, and that is the need to begin with high-quality, clean wheat.

To begin with, the wheat must be cleaned, of course. The objective of the cleaning process is to remove the dust, stones, unsound wheat kernels, and any other nonwheat impurities that may be present in the wheat delivered to the mill.

The cleaning process is a carefully designed system taking into account several factors including wheat type and origin. The economic impact of the cleaning process is monitored carefully, as well, for the important reason that operating and maintaining the equipment adds to the flour production costs.

A key goal in the cleaning process centers on balancing the need to maximize the removal of unwanted impurities with the desire still to minimize the removal of good, sound wheat kernels. On the surface, that sounds pretty basic, but this aspect can have a huge impact on the bottom line.

One often overlooked consideration in the cleaning process is its impact on the quality of the finished product. Important flour quality characteristics such as ash and color are affected by the cleanliness of the wheat delivered to the mill.

Management



Mark Fowler

Dealing with DON

In addition to the need for clean wheat, another major flour quality characteristic that can be addressed in the cleaning process is the presence of deoxynivalenol (DON), often referred to

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DON is a mycotoxin that may occur in wheat infected by fusarium head blight (FHB). FHB is a disease that can infect wheat heads, when wet conditions exist during the flowering and grain-filling stages of plant growth.

While the presence of FHB doesn't always guarantee that DON exists in the wheat, a higher level of FHB-infected or scabby wheat kernels still can correlate to a greater risk of DON.

Detecting DON's Presence

DON would have to be consumed in high amounts to pose a health hazard to humans or animals, but it does impact flavors in finished products and milling efficiencies.

The U.S. Food and Drug Administration (FDA) sets the advisory level for the presence of DON in wheat-based food products (see table on this page).

The allowable presence of DON in wheat flour, bran, and germ that may be consumed by humans is one part per million (ppm). One ppm is one gram in a metric ton or roughly one wheat kernel in a bushel. Some bakeries and food industries may have lower require-

ments depending on their product standards.

The FDA does not have a standard or advisory level for wheat itself, because it is considered a raw material for the milling industry. For the milling industry, rejecting wheat deliveries with high levels of DON is the standard practice.

Wheat accepted for milling generally has a maximum level of two ppm, because normal milling practices are capable of

reducing the concentration to acceptable levels in the finished flour.

Wheat used for whole grain flour must meet the FDA requirement of one ppm. Wheat destined for the export market is subject to the standards and purchase contracts that may limit DON levels. The normal standard for most of the global industry is the same maximum two ppm as used in the U.S. milling industry; however, some countries use lower limits. ►

Food and Drug Administration Advisory levels for DON in Finished Wheat Products and By-products (in parts per million)

1 ppm

Finished wheat products for human consumption such as flour, bran, and germ.

5 ppm

Wheat and wheat by-products used in swine rations providing that these ingredients are less than 20% of the diet.

Wheat and wheat by-products used in rations for all other animals providing that these ingredients are less than 40 % of the diet.

10 ppm

Wheat and wheat by-products used for ruminating beef and feedlot cattle older than four months and for poultry providing that these ingredients are less than 50% of the diet.

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The Cleaning Challenge

Advances in wheat cleaning technology enable the miller to accept even higher levels DON when poor harvesting conditions make it necessary; however, this practice presents other economic and product challenges.

From an operating standpoint, the miller's greatest challenge in managing the level of DON in wheat is that higher levels of DON do not necessarily correlate with physical damage to the wheat kernel.

When infected early in the growing cycle, wheat will be impacted significantly more by producing lighter-density, shrunken, and discolored kernels.

A light, pinkish coloring commonly is associated with DON-infected wheat kernels. Wheat infected later during its developmental stages will show less or no visible damage; however, it still may contain higher levels of DON.

The most common method of removing DON-infected wheat is to take advantage of the underdeveloped, low-density kernels.

Incorporating a gravity table or concentrator in the cleaning process allows



Color sorters have become more highly accurate in separating out impurities in grains. Photo by Karl Ohm.

the miller to make a separation between heavy and light wheat fractions.

This method is effective, but it may cause an excessive loss of good-quality wheat not infected with DON. Recently, optical sorting has increased millers' options in managing DON-infected wheat.

Optical Sorting

The inclusion of optical sorting, in addition to density separation, allows the miller to adjust the cleaning system quickly to reduce the loss of quality wheat.

Advances in optical sorting enable the miller to better identify and remove DON-infected kernels in the cleaning process prior to milling.

Color or optical sorting has been available to the food industry since the early 1930s, when the first machines were used to sort dry beans and peas.

Early on, the durum milling industry adopted optical sorting in the cleaning process due to the concern over ergot's impact on product quality and safety.

The early optical sorters were monochromatic only sorting grain based on shades of black and white.

As technology improved, higher-resolution bi-chromatic cameras were incorporated into the machines. The improved resolution in a wider color spectrum allowed the detection and removal of more subtle color defects.

More recent developments in optical sorting technology integrate full color red-green-blue (RGB) cameras, infrared, and even ultraviolet light spectrums permitting the detection and removal of impurities and defects with invisible opti-



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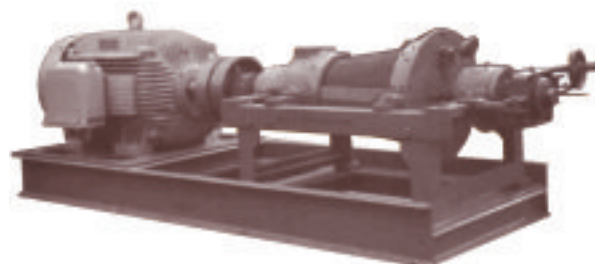


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Advances in optical sorting have not been limited to improved camera resolution. Greater light intensity using fluorescent or halogen lighting contributes to more accurate separation of impurities.

Higher-speed, more reliable ejectors have improved the precision in the removal of defects once they are detected. Better distribution and uniformity of the feeders delivering the wheat into the machines have increased operating capacities.

Economic Impacts

The ability to remove DON does not change the economic impact of the diseased kernels, nor does it mean that a mill can accept excessively high levels of DON contamination.

Although technology has allowed the efficient removal of DON-infected wheat kernels, it has created another problem — the disposal of DON-impacted kernels, once they are removed.

In addition to the advisory levels for DON in wheat products for human consumption, the FDA has advisory levels of DON for products used for animal feed.

For wheat and wheat byproducts

Advances in optical sorting have not been limited to improved camera resolution. Greater light intensity using fluorescent or halogen lighting contributes to more accurate separation of impurities.

used in feed rations for ruminating beef and feedlot cattle older than four months and for poultry, the allowable level is 10 ppm, as long as the product is less than 50% of the animal's diet.

For wheat and wheat byproducts used in feed rations for swine, the allowable level is 5 ppm, as long as the product is less than 20% of the animal's diet. The level also is a maximum 5 ppm for products fed to all other animals, providing the level of use is limited to less than 40% of the animal's diet.

Careful management of the screenings is necessary to prevent exceeding these allowable levels. Kernels with excessive

concentrations of DON may cause the screenings from the cleaning process to be unsuitable for consumption by humans or animals, which would require other means of disposal.

Summary

In summary, it is important to consider the impact of the wheat cleaning process on the quality of the finished product.

Technology is changing how the wheat milling industry manages the milling process, including the removal of DON-infected wheat kernels and other impurities in the cleaning process.

However, the ability to remove the DON-infected kernels does not completely eliminate the negative economic impact or allow for the ability to use wheat with excessively high levels of DON.

Optical sorting does offer the wheat industry greater options in managing the problems caused by DON.

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